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STUDIES ON THE EFFECT OF INTEGRATED NUTRIENT MANAGEMENT IN GROWTH ATTRIBUTES OF SUNFLOWER IN LEGUME INTERCROPPING SYSTEM

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Abstract

Field investigation was conducted at Annamalai University Experimental Farm, Annamalainagar to formulate the effect of integrated nutrient management in growth attributes of sunflower legume intercropping system. The experiment was conducted during March to June, 2014 in split plot design with three replications. All the treatments significantly influenced the crop yield components and yield of sunflower. Results of the experiment showed that black gram was the most compatible and profitable intercrop in terms of sunflower equivalent yield which fetched the highest monetary returns. Among the integrated nutrient management practices studied, application of 50 per cent RDF + vermicompost @ 5 tonnes ha^{-1} (S_4) significantly improved the values of varied growth parameters of sunflower resulting in enhanced monetary benefit in terms of net income and return $rupee^{-1}$ invested.

Key words: Nutrient managements, legume Intercropping System, integrated nutrient management

Introduction

Sunflower (*Helianthus annuus* L.) is one of the fastest growing oilseeds in India. India has the fourth largest area under sunflower with 18.12 million hectares in the world. The area under sunflower crop in world is 18.12 million hectares and production is 22.03 metric tonnes with the productivity of 1216 kg ha^{-1}. Whereas, in India the area under sunflower crop is 0.55 million ha and production was 0.42 metric tonnes with the productivity of 753 kg ha^{-1}. Sunflower is an important oilseed crop of the world and it ranks third in production next to groundnut and soybean. Sunflower is an important for its premier oil and manifold uses of both industrial and pharmaceutical importance. Its cultivation has gained momentum due to its special features like short duration, photoperiod insensitivity, drought tolerance, adaptability to wide range of soil and climatic situations, lower seed rate, high content of quality cooking oil and high seed multiplication ratio. The exponential growth of area under sunflower cultivation is an unparalleled example for any crop and this stands testimony for its suitability to fit to different cropping systems and patterns in the country (Imran *et al.,* 2011). The practice of intercropping is of prime significance where in the total productivity of the system could be enhanced with reduced risk which favours small and marginal sunflower cultivating farmers. Through increased addition of crop residues the intercropping system also provides enhanced soil biological activity, nutrient availability and residual soil fertility. Since sunflower is being planted widely in rows, it provides an excellent opportunity to accommodate short stature intercrops like pulses. The present level of fertilizer production in India is not enough to meet the total plant nutrient requirement. The continuous use of high level of chemical fertilizers is adversely affecting the sustainability of agriculture production and causing environmental pollution. In coming years a major issue in designing sustainable agriculture system will be the management of soil organic matter and the rational use of organic inputs such as animal manure, bio-fertilizers etc,. However, since organic manure cannot meet the total nutrient needs of modern agriculture. Integrated use of nutrient from fertilizer and organic manure sources seems to be need of the time. The basic concept of the integrated nutrient

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management system (INM) is the maintenance of yield stability through correction of marginal deficiency of secondary nutrients and micronutrients enhancing efficiency of applied nutrients and providing favourable soil physical conditions. Integrated and balanced use of nutrients through inorganic and organic sources of fertilizer is prerequisite to sustain soil fertility, supply of nutrients to optimum level and to produce maximum crop yield with minimum inputs. Imbalanced soil nutrients status as a result of the continuous usage of chemical fertilizers, its escalated costs and pollution hazards to agro-ecological situations are the other factors that weigh in favour of INM.

Materials and Methods

Field investigation was conducted at Annamalai University Experimental Farm, Annamalainagar during March-June, 2014. The experiment was laid out in split plot design with three replications. The main treatment comprised of sole sunflower cropping (M_1), sunflower+ blackgram (M_2) and sunflower+ cowpea (M_3). The sub-plots comprised of five treatments involving 100 per cent recommended dose of fertilizer (RDF) (S_1), 50 per cent RDF + pressmud @ 10 tonnes ha^{-1} (S_2), 50 per cent RDF + enriched FYM @ 750 kg ha^{-1} (S_3), 50 per cent RDF + vermicompost @ 5 tonnes ha^{-1} (S_4), 50 per cent RDF + soil application of *azospirillum* @ 2 kg ha^{-1} (S_5). The Experimental Farm is characterized by tropical climate with a mean annual rainfall of 1500 mm distributed over 55- 60 rainy days. The weather of Annamalainagar is moderately warm with hot summer months. While the maximum temperature ranges from 28.1ºC to 38.3ºC with a mean of 33.2ºC, the minimum temperature ranges from 18.9ºC to 27.5ºC with a mean of 23.2ºC and relative humidity ranges from 78 to 96 per cent. The soil of the experimental field was clayey loam. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium. A seed rate of 15 kg ha^{-1} was followed. Sunflower seeds @ one seed per hill were dibbled in lines 60 cm apart adopting a spacing of 30 cm between the plants. The seeds of intercrops *viz.,* black gram and cowpea @ 10 kg ha^{-1} were dibbled in line. Thinning and gap filling were done on 15th day after sowing (DAS). One hand weeding was given on 20 DAS. Need based plant protection measures were also followed.

The recommended dose of inorganic fertilizer nutrients *viz.,* nitrogen @ 60 kg ha^{-1} through urea, phosphorus @ 90 kg ha^{-1} through single superphosphate and potash @ 60 kg ha^{-1} through muriate of potash was applied, where in half dose of N and K_2O and entire dose of P_2O_5 were applied as basal, the remaining nitrogen and potash were applied as top dress on 30 DAS. As per the treatment schedule pressmud @ 10 tonnes ha^{-1}, EFYM @750 kg ha^{-1}, vermicompost @ 5 t ha^{-1} and *azospirillum* 2 kg ha^{-1} were given along with 50 per cent RDF. No separate inorganic fertilizer application was done for the intercrops *viz.,* blackgram and cowpea. Initial irrigation was given immediately after sowing of sunflower seeds with adequate care to avoid excess soaking of water. The varied growth attributes *viz*., plant height, leaf area index and dry matter production were recorded at various stages of crop growth. The data on the various parameters studied during the course of investigation were analysed statistically as per the procedure suggested by Panse and Sukhatme (1978).

Results and discussion

The data recorded on sunflower plant height (30 DAS and at harvest), LAI and DMP (30 DAS and at harvest) are given in table 1.

Irrespective of the stages of crop growth the sole cropping of sunflower exerted significant influence on sunflower plant height. Sole cropping of sunflower (M_1) significantly registered greatest plant heights of 58.49 and 150.12 cm respectively at 30 DAS and at harvest. This was followed by the intercropping of blackgram in sunflower (M_2) at all stages of crop growth. The lowest sunflower plant height of 54.83 and 142.86 cm at respective stages of crop growth were recorded with the intercropping of cowpea in sunflower (M_3).

Regarding the nutrient management practices evaluated, application of 50 per cent RDF with vermicompost @ 5 t ha^{-1} (S_4) significantly resulted with the greater plant heights of 61.51 and 154.66 cm at 30 DAS and at harvest respectively. This was followed by the 50 per cent RDF + enriched FYM @ 750 kg ha^{-1} (S_3) at all stages of crop growth. This was on par with 50 per cent RDF + pressmud @ 10 t ha^{-1} (S_2). Regardless stages of crop growth the application of recommended NPK alone (S_1) resulted in the lowest values of plant height (51.71 and 138.27 cm) at 30 DAS and at harvest.

Regarding interactions, sole cropping of sunflower supplied with 50 per cent RDF with vermicompost @ 5 t ha^{-1} (M_1S_4) significantly registered the highest plant height of at respective stages of crop growth. This was followed by the intercropping of blackgram in sunflower (M_2S_4) supplied with RDF with vermicompost @ 5 t ha^{-1} at all the stages of crop growth. The lowest plant height was noticed with the intercropping of cowpea in sunflower + recommended NPK alone (M_3S_1).

Regardless the cropping seasons the intercropping

Table 1. Effect of INM in sunflower legume intercropping on growth attributes of sunflower

Treatments	Plant height(cm)		LAI	DMP (kg ha^{-1})	
	30 DAS	harvest	60 DAS	30 DAS	harvest
Main plots					
M_1 : Sole sunflower	58.49	150.12	4.65	631.31	3886.26
M_2 : sunflower + blackgram	56.66	146.50	4.35	617.43	3775.05
M_3 : sunflower + cowpea	54.83	142.86	4.35	602.01	3666.02
SEm±	0.76	1.78	0.05	6.58	54.13
CD (P=0.05)	1.53	3.57	0.11	13.16	108.27
Sub plots					
S_1: RDF (100 per cent NPK)	51.71	138.27	4.14	575.96	3542.46
S_2: 50 % RDF+ pressmud @10 t ha^{-1}	56.96	146.66	4.56	623.16	3784.82
S_3: 50 % RDF+ EFYM @ 750 kg ha^{-1}	58.89	150.44	4.64	634.66	3886.09
S_4 : 50 % RDF+Vermicompost @ 5 t ha^{-1}	61.51	154.66	4.81	652.30	4003.20
S_5: 50 % RDF+ *Azospirillum* @ 2 kg ha^{-1}	54.23	142.43	4.32	598.71	3662.30
SEm±	1.20	2.06	0.072	8.67	57.15
CD (P=0.05)	2.40	4.12	0.14	17.34	114.31
Interaction					
Sub treatment at same level of main treatment					
SEm±	0.99	1.91	0.05	7.57	62.51
CD (P=0.05)	1.98	3.82	0.11	15.14	125.02
Main treatment at same or different level of sub treatment					
SEm±	0.93	1.98	0.08	7.66	62.62
CD (P=0.05)	1.87	3.96	0.16	15.32	125.24

in sunflower with cowpea (M_3) or blackgram (M_2) failed to alter LAI of sunflower on 30 DAS. However, the sole cropping of sunflower (M_1) significantly enhanced the LAI up to 4.65 at harvest. However, this was followed by intercropping of blackgram in sunflower (M_2) which was on par with intercropping of cowpea in sunflower (M_3). In respect to the nutrient management practices, 50 per cent RDF with vermicompost @ 5 t ha^{-1} (S_4) significantly resulted with the highest LAI at 60 DAS. This was followed by the 50 per cent RDF + enriched FYM @ 750 kg ha^{-1} (S_3). This was on par with 50 per cent RDF + pressmud @ 10 t ha^{-1} (S_2). Regardless stages of crop growth the application of recommended NPK alone (S_1) resulted in the lowest values of LAI. Regarding interactions, sole cropping of sunflower supplied with 50 per cent RDF with vermicompost @ 5 t ha^{-1} (M_1S_4) significantly registered the highest LAI. This was followed by the intercropping of blackgram in sunflower (M_2S_4) supplied with RDF with vermicompost @ 5 t ha^{-1}. Intercropping of cowpea in sunflower + application recommended NPK alone (M_3S_1) resulted in the lowest values of LAI.

The dry matter production (DMP) of sunflower was influenced by the intercropping and the varied integrated nutrient management practices. Sole cropping of sunflower (M_1) significantly recorded higher DMP of 631.31 and 3886.26 kg ha^{-1} respectively at 30 DAS and at harvest during. This was followed by intercropping of black gram in sunflower (M_2) at all stages of crop growth. Intercropping of cowpea with sunflower (M_3) resulted in the least DMP.

Regarding the varied nutrient treatments evaluated, application of 50 per cent RDF with vermicompost @ 5 t ha^{-1} (S_4) significantly registered higher DMP of 652.30 and 4003.20 at 30 DAS and at harvest. This was followed by the 50 per cent RDF+enriched FYM @ 750 kg ha^{-1} (S_3) at all stages of crop growth. This was on par with 50 per cent RDF + pressmud @ 10 t ha^{-1} (S_2). Regardless stages of crop growth the application of recommended NPK alone (S_1) resulted in the resulted in the least DMP. Regarding interactions, sole cropping of sunflower supplied with 50 per cent RDF with vermicompost @ 5 t ha^{-1} (M_1S_4) significantly accounted for higher DMP. This was followed by the intercropping of blackgram in sunflower (M_2S_4) supplied with RDF with vermicompost @ 5 t ha^{-1} at all the stages of crop growth. The least DMP was observed with intercropping of cowpea in sunflower + recommended NPK alone (M_3S_1).

The pulse crops *viz.,* black gram and cowpea were raised as intercrops with sunflower under adcrop population per unit area together with limited supply of plant nutrients, the energy rich pulse crops might have offered stiff competitions for the available resources resulting in lower values of varied growth components of sunflower *viz.,* plant height and leaf area index which reflected upon in reduced dry matter production under intercropped situation. In respect of intercrop cowpea, its vigorous crop growth during initial growth phase as evident from the data on plant height and LAI might have offered high degree of competition to sunflower for the available resources and resulted in lower values of

sunflower growth components. Similar inferences were documented by Sanjeeb Kumar Sahoo *et al.* (2006). On the other hand, an uninterrupted availability of varied resources *viz.,* solar interception, soil moisture and nutrients for sole crop sunflower might have helped the crop to utilize the resources to a great extent resulting in enhanced values of varied growth parameters *viz.,* plant height LAI, DMP and growth indices. The resultant values of growth parameters with blackgram intercropped situations (M_2) might be due to the less competitiveness and compatibility of blackgram with sunflower. These results are in agreement with the findings of Rajvir Sharma and Sharma (2002).

The integrated nutrient management approach of incorporating 50 per cent N substitution with vermicompost in combination (S_4) significantly resulted in the greatest plant height and leaf area index of sunflower. Application of vermicompost might have imparted distinct improvements in soil physical properties *viz.,* texture, structure and porosity (Chaudhary *et al.,* 2004) and also might have enhanced the availability of essential plant nutrients Arancon *et al.,* 2006. The presence of growth promoting substances, such as NAA, IAA and humic acids in vermicompost (Arancon *et al.,* 2006) could have also contributed to the synergistic effect on crop growth and development. The consistent increments observed with the values of plant height and LAI might have positively reflected on dry matter production and the values of varied crop indices. Increments in values of growth attributes of sunflower through the practice of INM were also documented by Kavitha and Swarajya Lakshmi (2003). Recommended NPK alone (control, S_1) resulted in the least values of growth parameters, attributable to the absence of beneficial effect of vermicompost which contains nutrients in forms that are readily taken up by the plants such as nitrates, exchangeable phosphorus and soluble potassium, calcium and magnesium (Atiyeh *et al*., 2002). The results are in conformity with the findings of Khatik and Dikshit (2001).

Interaction of sole cropping of sunflower supplied with 50 per cent RDF with vermicompost @ 5 t ha^{-1} (M_1S_4) significantly resulted in enhanced growth attributes of sunflower. This might be due to absence of competition from intercrops *viz.,* blackgram and cowpea resulting in optimum availability of resources such as light, moisture and nutrients from vermicompost. The results are in conformity with the findings of Rehman et al., (2009).

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